An EET Project for MEAP Students

Barbara Christe, Patrick Gee, Marvin Needler
Indiana University-Purdue University at Indianapolis

Abstract

The Electrical Engineering Department at Indiana University – Purdue University at Indianapolis has designed and implemented a project for participants in the Minority Engineering Advancement Program (MEAP). 6^{th} – 12^{th} grade students interested in engineering and technology complete a project during a summer session designed to encourage minorities to consider engineering and technology as potential careers. A volume monitor unit was chosen for the summer of 1998. A microphone was used to convert sound into electricity and then the sound is amplified. The intensity of the signal was then displayed using an LM3914N to drive a graduated number of LEDs. The project was produced in kit form containing a printed circuit board and circuit components as well as a battery and box. Throughout the project sessions, casual conversation provided the opportunities to discuss career options in electrical engineering technology as well as the educational path necessary to reach such goals. The Purdue School of Engineering and Technology faculty promotes and supports this program as a community effort as well as a recruitment tool to promote its academic programs to minority youth.

I. Introduction

The Minority Engineering Advancement Program (MEAP) was established in 1976 in response to the small number of minorities in the engineering profession. MEAP strives to circumvent some of the inhibitors that prevent minorities from selecting engineering and technology as potential careers. The summer component of the program is currently open to 6^{th} – 12^{th} grade students interested in engineering and technology. Public and private schools are contacted with application information to recommend possible candidates. Once the students have applied to the program, a final selection process takes place by the MEAP staff.

Participants are exposed to electrical engineering technology through the completion of a project. This project must meet three criteria. First, it must produce a product that is interesting and somewhat useful to the students when they bring it home. Secondly, the time necessary for completion must not exceed the allotted number and duration of the MEAP sessions. Third, the project should incorporate several principles of electricity and electronics to demonstrate the wide variety of techniques employed to convert electricity into a useful tool. Since MEAP students may return for two or more summers, a different project is designed each year. A volume monitor unit was chosen for the summer of 1998. A microphone was used to convert sound into electricity and then the sound is amplified. The intensity of the signal was then displayed using an LM3914N to drive a graduated number of LEDs. The project was produced in kit form containing a printed circuit board and circuit components as well as a battery and box.

After a short introduction to Electrical Engineering Technology, students begin the project. Throughout the project sessions, casual conversation provided the opportunities to discuss career options in electrical engineering technology as well as the educational path necessary to reach such goals. The Purdue School of Engineering and Technology faculty promotes and supports this program as a community effort as well as a recruitment tool to promote its academic programs to minority youth.

II. MEAP and Its Participants

The Minority Engineering Advancement Program identifies, recruits and selects 6 – 12th grade students by working directly with local area schools and by re-enrolling previous participants of the program. Applications for the program are mailed directly to the math and science teachers and guidance counselors. The teachers and counselors are asked to pass the application on to students with good math and science grades and an interest in technical areas. The program information and application is reviewed and completed by interested student and parents. A recommendation from the school, grade information and the application is returned to MEAP. The application is ranked by MEAP using the following criteria: program availability by grade level, academic grades, recommendation and application information. All previous MEAP participants are also given an opportunity to return each semester until they graduate based on continued positive academic performance.

The Minority Engineering Advancement Program (MEAP) concentrates on the following objectives to achieve its goals:

1. To identify, recruit, and select minority students (grades 6-12) with demonstrated academic potential and to expose them to the fields of engineering and technology.
2. To assist students to become enrolled in college (post-secondary education) and provide assistance in helping them obtain financial aid.
3. To increase the students' awareness of career options available to engineers and technologists.
4. To facilitate students' access to and interaction with positive role models from the fields of education and industry who will serve MEAP as workshop instructors, counselors, and mentors for students.
5. To provide hands-on laboratory experiences and academic instruction similar to that of a typical first year of study in an engineering or technology curriculum.
6. To demonstrate work-place environments by providing students with tours of local industries.
7. To provide MEAP graduates with valuable summer work experience in engineering and technology-related fields within local industries.

MEAP receives contributions from two main sources. Purdue School of Engineering and Technology provides 60 percent of the funding while remaining 40 percent comes from local, technically orientated industries. To solicit funding, area companies are visited by IUPUI faculty who present a MEAP program summary. Community-minded companies provide a gift in kind to the school that is earmarked for MEAP. Contributing companies include Ford Motor

Company, United Technologies, Carrier Corporation, and Raytheon Technical Services Company.

III. The Project

Each year, a great deal of effort goes into the selection and design of a suitable project for the summer MEAP experience. For the summer of 1998, a Volume Monitor Unit was identified as a good choice for the students and instructors. The schematic is shown in Figure 1 and the board layout is shown in Figure 2. The circuit uses an LM3914N decoder to drive a graduated number of ten LEDs. Examples of previous projects include an electric timer, a telephone amplifier, a six-bit random-event generator (electronic dice) and a variable electrical energy source.

College student mentors, selected by MEAP, were stepped through the EET project, with faculty assistance, a week prior to the beginning of the summer sessions. Each mentor constructed his or her own Volume Monitor Unit. As the mentors progressed, they were made aware of potential trouble spots and pitfalls that could occur when students arrived and their groups were formed. This also provided MEAP with spare, functional units that could replace a student's non-functional one when the summer program ended.

In July, 1998, students were grouped according to age and placed in three sections. The first were participants in high school. Many had experienced MEAP summer sessions before. The second group was generally in grades 7 and 8. Many members of this group had also participated in MEAP before. The third group was new to MEAP and was in the sixth and seventh grade. The students worked with the EET faculty for approximately one and a half hours in each session of a period of several weeks. The total number of hours spent within the department was six.

The sessions were nearly identical for each group. Variations were limited to additional career information provided to the older participants. Each group began with introductions and a brief explanation of electrical engineering technology. A comparison with electrical engineering was offered as well. After the initial information was provided, laboratory safety was explained. No assumptions of prior student knowledge were made. Discussion points included:

- the burn hazards of soldering irons
- the danger of voltage
- the safety of battery voltages
- body surface grounding
- hazard of lead poisoning due to solder handling
- warnings regarding various equipment located in the laboratory room, which was not used by MEAP
- general laboratory rules, for example, no eating in the laboratory

Once general safety had been discussed, soldering techniques were explained and practiced. A training video, "Hand Soldering -- Soldering Techniques", IPC, was shown. This presentation illustrated functional and acceptable soldering techniques. The video was paused at certain points to emphasize proper solder connections.

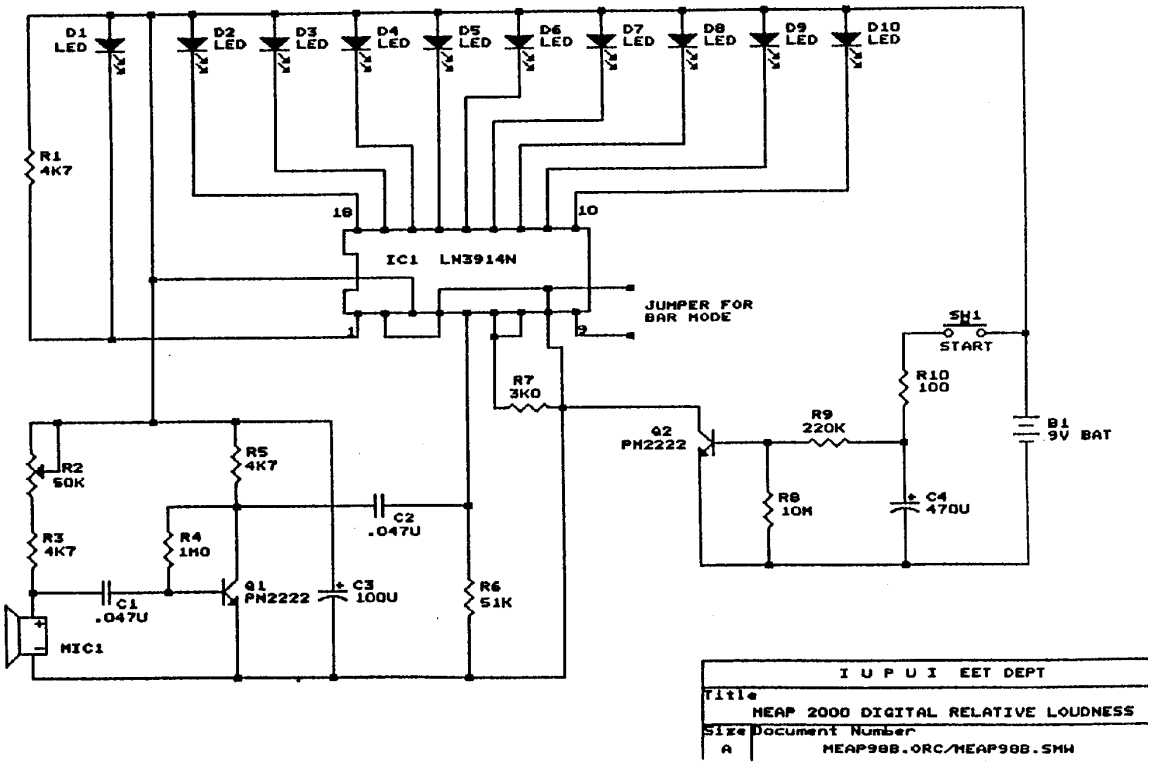

Figure 1

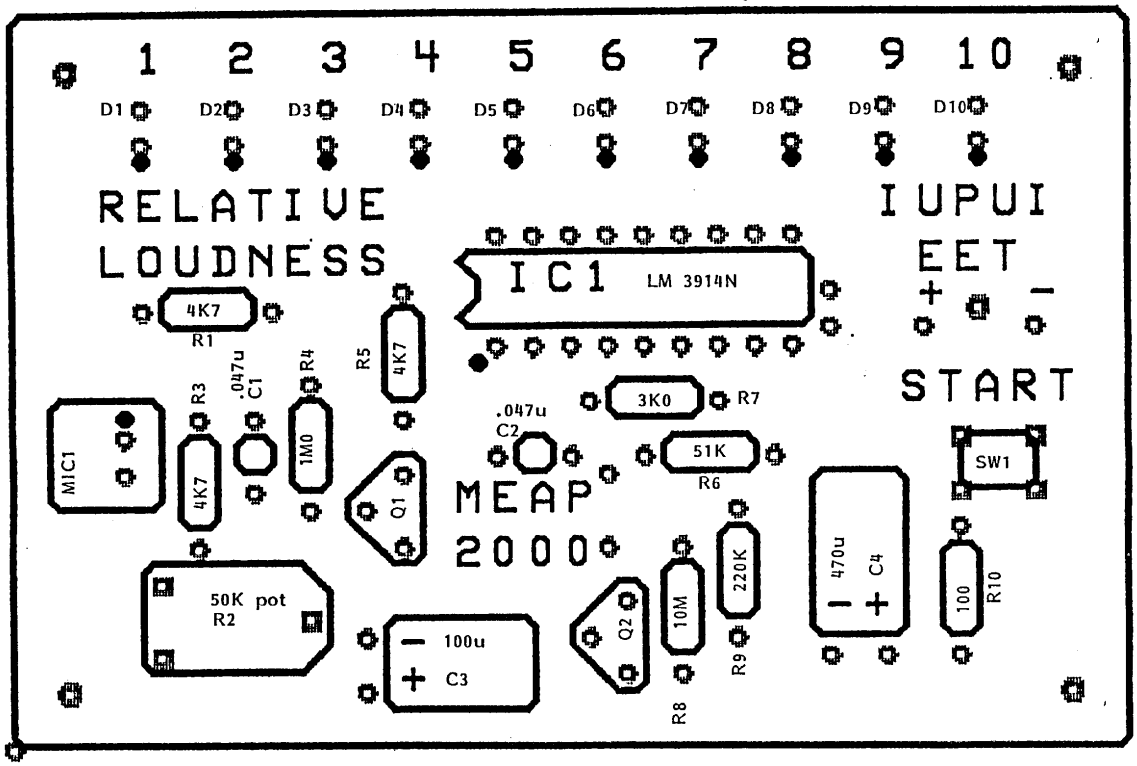

Figure 2

A brief introduction to voltage, current, and resistance was included at this point in the session. Fundamental theory and appropriate units were discussed. Component types, including capacitors and transistors were identified. The project was designed to require very little knowledge of electronics and therefore, little emphasis was necessary in this area.

Once this information was presented, students spent time practicing their soldering techniques using surplus boards and various spare components. Close supervision by the instructor and MEAP mentors assisted in the development of acceptable skills. Students were motivated to solder correctly, when the importance of functional connections was explained in terms of a function volume monitor unit.

Extremely detailed instructions were provided to guide the student through the assemble process. Participants were constantly referred back to the handout in order to condition them to use the instructions as a tool, and not rely on the faculty member and mentors to explain the steps. The hand-out included a check list to ensure that the student completed each instruction in the order directed. Progress was monitored in a significant way as each student was required to request the instructor for the next required part.

The steps to create the volume monitor unit included:

- installing the resistors on the board and clipping leads to appropriate length
- soldering the resistors
- mounting and soldering the IC socket
- mounting and soldering the capacitors
- mounting and soldering the transistors
- mounting and soldering the LEDs
- mounting and soldering the potentiometer, microphone and battery connectors
- installation of the IC (including instruction regarding orientation and insertion)
- testing for proper performance
- mounting inside case

IV. Experiences of the Participants

Many students were unable to have a functional unit after assembly. They were instructed on the examination of solder connections and chip and LED orientation. This detective work was tremendously rewarding when they were able to locate and fix the problems. Very few students could not construct a functioning volume monitor unit. Those who fit this category were given replacement units.

Direction and monitoring was required at all grade levels. Socializing was a primary distraction for some students given the nature of the independent learning mode. It was this self-paced method of delivery that enhanced the experience of the participants. Faster students often assisted others as well as looked for errors in non-functional units.

This totally hands-on activity gave answer to the question “when will we ever use this.” The one-on-one instruction provided opportunity for casual inquiries into student career goals. Questions from participants about types of engineering and potential employment were easily

addressed. Students could ask questions without peer pressure in the laboratory environment, without other students involved. Also, female students could address specific career questions without embarrassment or intimidation.

V. Project Goals and Results

The primary objective for MEAP participants was exposure to the EET field. This project was the vehicle for the experience. It provided a take-home object to put a tangible result into a teenager's hands. Although there was very little formal presentation or instruction, the EET message is still visible to the participant.

The students learn a little about electronics but experience its application first hand – they can see a reason to learn. Participants understand much more about the electronics that surround them. It is also possible that they can see the potential of an EET degree.

VI. Conclusion

The two-pronged goal of the EET department involved in MEAP combines the enhancement of career exploration and the awareness of post-secondary school education. While MEAP might be viewed as a recruiting tool for IUPUI, it also serves as a community service, advancing the technological awareness and broadening the experiences of the minority secondary school members and their family and classmates in the Indianapolis area.

BARBARA CHRISTE
Barbara Christe is an Assistant Professor and Program Director of Biomedical Electronics Technology in the Electrical Engineering Technology Department at IUPUI. Prior to her arrival at IUPUI in 1998, she was an Assistant Professor in the Electrical Engineering Technology Department at the Community College of Rhode Island for 12 years. She received her Masters Degree in Clinical Engineering from Rensselaer at Hartford and her BS in Engineering from Marquette University.

PATRICK GEE
Patrick Gee is a Visiting Professor for the Mechanical Engineering Technology Department and Director of the Minority Engineering Advancement Program at Indiana University-Purdue University at Indianapolis. Previously, he held a manufacturing engineering position at Allison Transmission, Division of General Motors. He received his Master of Science Degree and Bachelor of Science Degree in Mechanical Engineering from Purdue University at Indianapolis. He also coordinates internship and cooperative education programs for the School of Engineering and Technology.

MARVIN NEEDLER
Marvin Needler is a Professor of Electrical Engineering Technology and Electrical Engineering and Chairman of Electrical Engineering Technology, Purdue School of Engineering & Technology, IUPUI, He earned his B.S.E.E. and M.S.E.E. at Purdue University and his Ph.D. in Systems Science/Electrical Engineering, Michigan State University. He has consulted with over twenty companies and as a forensic engineer. He is a registered professional engineer in the State of Indiana.